

This application claims ~~priority on~~ the benefit of International Patent
Application No. PCT/US00/14139, filed May 23, 2000, which claims the benefit of U.S.
Provisional Patent Application No. 60/142,587 filed July 7, 1999.

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1. In a voice coil actuator (~~100, 130, 160, 170~~) of the type comprising a coil (~~108, 118, 128, 138, 168, 178~~), an armature (~~106, 136, 166, 176~~), a housing (~~102, 132, 162, 172~~) and a magnet (~~104, 134, 144, 154, 164, 174~~), wherein the armature (~~106, 136, 166, 176~~) is disposed at least partially within the housing (~~102, 132, 162, 172~~) and movable relative thereto and the coil (~~108, 118, 128, 138, 168, 178~~) and the magnet (~~104, 134, 144, 154, 164, 174~~) are disposed relative to each other so as to induce movement of the armature (~~106, 136, 166, 176~~) relative to the housing (~~102, 132, 162, 172~~) when the coil (~~108, 118, 128, 138, 168, 178~~) is energized by an electrical current, the improvement comprising:

at least one of the coil (~~108, 118, 128, 138, 168, 178~~), the magnet (~~104, 134, 144, 154, 164, 174~~) and the housing (~~102, 132, 162, 172~~) being nonuniform in orientation relative to the armature (~~106, 136, 166, 176~~),

whereby displacement of the armature (~~106, 136, 166, 176~~) relative to the housing (~~102, 132, 162, 172~~) will be substantially linearly proportional to electrical current flowing through the coil (~~108, 118, 128, 138, 168, 178~~).

2. The voice coil (~~108, 118, 128, 138, 168, 178~~) actuator according to claim 1, wherein the movement of the armature (~~106, 136, 166, 176~~) relative to the housing (~~102, 132, 162, 172~~) is radial in nature.

3. The voice coil actuator (~~100, 130, 160, 170~~) according to claim 1, wherein the movement of the armature (~~106, 136, 166, 176~~) relative to the housing (~~102, 132, 162, 172~~) is axial in nature.

4. The voice coil actuator (~~100, 130, 160, 170~~) according to ~~any of claims 1-3~~ claim 1, wherein the coil (~~108, 118, 128, 138, 168, 178~~) is carried by the armature (~~106, 136, 166, 176~~).

5. The voice coil actuator (~~100, 130, 160, 170~~) according to ~~any of claims 1-3~~ claim 1, wherein the magnet (~~104, 134, 144, 154, 164, 174~~) is carried by the armature (~~106, 136, 166, 176~~).

6. The voice coil actuator (~~100, 130, 160, 170~~) according to ~~any of claims 1-5~~ claim 1, wherein the coil (~~108, 118, 128, 138, 168, 178~~) is a single winding.

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Appendix B

7. The voice coil actuator (~~100, 130, 160, 170~~) according to ~~any of claims 1-6~~claim 1, wherein the coil (~~108, 118, 128, 138, 168, 178~~) is tapered.

8. The voice coil actuator (~~100, 130, 160, 170~~) according to ~~any of claims 1-7~~claim 1, wherein the housing (~~102, 132, 162, 172~~) is tapered.

9. The voice coil actuator (~~100, 130, 160, 170~~) according to ~~any of claims 1-8~~claim 1, wherein the magnet (~~104, 134, 144, 154, 164, 174~~) is nonuniform.

10. The voice coil actuator (~~100, 130, 160, 170~~) according to ~~any of claims 1-4~~claim 1, wherein the magnet (~~104, 134, 144, 154, 164, 174~~) is in the housing (~~102, 132, 162, 172~~).

11. The voice coil actuator (~~100, 130, 160, 170~~) according to ~~any of claims 1-4 and 10~~claim 1, wherein the magnet (~~104, 134, 144, 154, 164, 174~~) is radially contained in the housing (~~102, 132, 162, 172~~).

12. The voice coil actuator (~~100, 130, 160, 170~~) according to ~~any of claims 1-11~~claim 1, wherein the coil (~~108, 118, 128, 138, 168, 178~~) is linearly tapered.

13. The voice coil actuator (~~100, 130, 160, 170~~) according to ~~any of claims 1-11~~claim 1, wherein the coil (~~108, 118, 128, 138, 168, 178~~) is parabolically tapered.

14. The voice coil actuator (~~100, 130, 160, 170~~) according to ~~any of claims 1-11~~claim 1, wherein the coil (~~108, 118, 128, 138, 168, 178~~) is arcuately tapered.

15. The voice coil actuator (~~100, 130, 160, 170~~) according to ~~any of claims 1-11~~claim 1, wherein the coil (~~108, 118, 128, 138, 168, 178~~) is discontinuously tapered.

16. The voice coil actuator (~~100, 130, 160, 170~~) according to ~~any of claims 1-15~~claim 1, wherein the magnet (~~104, 134, 144, 154, 164, 174~~) is arcuately tapered.

17. The voice coil actuator (~~100, 130, 160, 170~~) according to ~~any of claims 1-15~~claim 1, wherein the magnet (~~104, 134, 144, 154, 164, 174~~) is discontinuously tapered.

18. The voice coil actuator (~~100, 130, 160, 170~~) according to ~~any of claims 1-15~~claim 1, wherein the magnet (~~104, 134, 144, 154, 164, 174~~) is parabolically tapered.

19. The voice coil actuator (~~100, 130, 160, 170~~) according to ~~any of claims 1-15~~claim 1, wherein the magnet (~~104, 134, 144, 154, 164, 174~~) is linearly tapered.

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